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A NOTE ON THE FAMILY CARYOPHYLLACEAE, WITH SPECIAL REFERENCE TO THE INDIAN SPECIES

N. C. MAJUMDAR

Botanical Survey of India, Howrah

ABSTRACT

This note provides with the general features of the family with discussions on the geographical distribution, phylogeny and systematic position, garden plants, and the medicinal and economic uses of a few species of the family. A detailed enumeration and description of taxa will be published later on in the "Flora of India".

NAME

The name Caryophyllaceae is derived from the old generic name *Caryophyllus* Moench, a synonym of *Dianthus* L. The name Caryophyllaceae Reichb. is conserved over the older name Alsinaceae Wahlenb.

DIAGNOSTIC CHARACTERS

The family is characterised by the opposite entire leaves with connate leaf-bases, a definite number of stamens, the 2-5 carpelled unilocular ovary with free-central placentation of the ovules and the 1-chambered capsule dehiscing by valves or teeth.

GEOGRAPHICAL DISTRIBUTION

The family is widely distributed throughout the world in the temperate and subarctic regions and high tropical mountains. Few species are found growing in the plains. The family had its origin and development in the mediterranean region. From this region migrations took place both eastwards and westwards, the number of migrants gradually decreasing as they go farther and farther from this place of origin. Thus the family is represented by 418 species in the Balkan peninsula whereas in India the total number of species is 140. Going farther, we find that in Malaya there is only one species representing the family. Regarding wideness of distribution, the family can be placed nearest to the Gramineae, as in this family there are many arctic forms and some are present in the Antarctica and also in the South Temperate Oceanic Islands. It is not represented in the tropical areas of some regions and in Western Australia. The family consists of only herbaceous forms and large woody plants are not found in this family. There are some widespread weeds which are cosmopolitan in distribution.

DISTRIBUTION IN INDIA

The Western part of the Himalayas is very rich in Caryophyllaceae. The Eastern Himalayas also contain a good number of representatives. Within the Indian limit, the Himalayas contain 130 species of the family. Only 10 species can be said to be non-Himalayan of which 2 occur in Assam, 1 in Bombay, 1 in Bengal, 3 in South India, 3 are distributed widely on the plains of India. Of the 130 species occurring in the Himalayas, 115 are strictly Himalayan, while the other 15 species are found also in other parts of India.

THE ENDEMIC SPECIES

D. Chatterjee (1960) stated that 50% of the Indian Caryophyllaceae are endemic in India. But during his studies on the family, the author has found that about 26% of the Indian species are endemic in India. That means out of 140 species 36 species are endemic in India. Most of the Indian endemic species are confined in different large areas in India and very few of them cross their respective boundaries. Thus 7 species are endemic in Eastern Himalayas, 13 in Western Himalayas, 4 in Nepal, 3 in Eastern India and 2 in South India. The others, 7 in number, spread over more than one of the above areas but confined within India. The Indian endemic species are listed below:

EASTERN HIMALAYA: *Stellaria lanata* Hook. f.; *Arenaria thangoensis* W. W. Smith; *A. sikkimensis* Majumdar; *A. balfouriana* Smith; *A. bhutanica* Majumdar & Babu; *Silene linae* Bocquet and *S. birgittae* Bocquet. WESTERN HIMALAYA: *Dianthus jacquemontii* Edgew.; *D. cachemiricus* Edgew.; *Stellaria semivestita* Edgew.; *S. himalayensis* Majumdar; *Arenaria ferruginea* Duthie ex Williams; *Silene falconeriana* Benth.; *S. kunawarensis* Benth.; *S. kumaonensis* Williams; *S. cancellata* (Jacq. ex Edgew. & Hook. f.) Majumdar; *S. laxantha* Majumdar; *S. chambaensis* Majumdar; *S. eduardi* Bocquet and *S. setaesperma* Majumdar. EASTERN INDIA (ASSAM & SYLHET): *Stellaria wallichiana* Haines; *Silene khasiana* Rohrb.; *S. vagans* C. B. Clarke. CENTRAL HIMALAYA (NEPAL): *Silene vautieri* Bocquet; *S. helleboriflora* Exell & Bocquet; *Stellaria mukerjeeana* Majumdar and *S. nepalensis* Majumdar & Vartak. SOUTH INDIA: *Polycarpaea diffusa* Wight & Arnott; and *Silene intrusa* Wight & Arnott.

The other endemic species which spread over more than one of the above mentioned areas, but restricted within India are *Silene stracheyi* Edgew.; *Gypsophila cerastioides* D. Don; *Stellaria patens* D. Don; *Minuartia foliosa* (Royle ex Edgew. & Hook. f.) Majumdar; *Arenaria blinkworthii* McNeill, *A. neelgherrense* Wight & Arnott. and *Stellaria depauperata* Edgew.

The non-endemic species or the wides include many cosmopolitan weeds as *Vaccaria pyramidata* Medic., *Spergula arvensis* L., *Silene armeria* Linn., *Cerastium glomeratum* Thuill., *Stellaria media* (Linn.) Vill., *Arenaria serpyllifolia* Linn., *Polycarpaea corymbosa* Lamk. Many of them were introduced by seeds mixed with seeds of ornamental plants or vegetables and occurred as escapes from cultivation, later on naturalised. A large number of species migrated towards India from the mediterranean region through Asia minor, Persia, Afghanistan, etc. and entered into N. W. India, thus increasing the concentration of population in Kashmir. Some of them are *Dianthus caryophyllus* Linn., *Silene vulgaris* (Moench.) Garcke, *S. viscosa* (Linn.) Pers., *Lychnis coronaria* (Linn.) Desr., *Cerastium cerastoides* (L.) Britton, *C. davuricum* Fisch., *Myosoton aquaticum* (L.) Moench., *Arenaria griffithi* Boiss., *Polycarpaea spicata* Wt. & Arn., *Stellaria palustris* Retz., and *Tunica stricta* (Bunge) Fisch. & Mey. Migrations have also taken place along other lines. *Sagina japonica* (Sw.) Ohwi has come from China via Eastern Tibet. This group of non-endemic species or wides is composed of 104 species of the family in India.

PHYLOGENY & SYSTEMATIC POSITION

Many botanists are of opinion that the family is primitive and it evolved from Ranalian ancestors. Bentham & Hooker (1862), Wernham (1911), Bessey (1895), Hallier (1912), Hutchinson (1926, 1934) and Benson (1957) all supported this view of origin of the family. Later on Takhtajan also supported this view of origin of the family. According to this view the family originated from Ranunculaceae and is the source of origin of Primulaceae and Gentianaceae and the apetalous reduced families such as Polygonaceae and Chenopodiaceae. The family is related to Portulacaceae, both of which had a common source of origin.

Another concept regarding the affinities of the family is that of Eichler (1875). He considered that the family originated from the Phytolaccaceae by conversion of the outer stamen whorl to petals and the outer carpel whorl to stamens. This view was accepted by Pax (1889), Wettstein (1935) and Rendle (1904, 1925), who consider the family to be more advanced than the amentiferous families.

The origin and affinities of the family is better represented by the first view (Lawrence, 1955).

The limits of the family have undergone slight changes from time to time by different botanists. The Paronychioideae or the Illecebraceae have long been included in the family. In De Candolle's Prodromus (1824) Caryophylleae appeared in Vol. I by Seringe and Paronychieae appeared as a separate order in Vol. 3 (1828). Bentham & Hooker (1862) subdivided the family into 3 tribes: Sileneae, Alsineae and Polycarpeae. Boissier (1867) considered the Sileneae, the Alsineae and the Paronychieae as three separate orders. Pax (1889) recognised two subfamilies—the "Silenoideae" and the "Alsinoideae" including two and seven tribes respectively. Pax & Hoffmann (1934) recognised three subfamilies: Paronychioideae with 5 tribes, Alsinoideae with 4 tribes and Silenoideae with 2 tribes. Most of the recent authors *e.g.* Clapham, Tutin & Warburg (1962), Bailey (1953), etc. accept the classification of Pax (1889), recognising only two subfamilies: 1. Silenoideae (sepals united) and 2. Alsinoideae (sepals free), merging the Paronychioideae with the Alsinoideae. It is better to accept this simple and natural classification based on free and united sepals.

CRITICAL CHARACTERS

Sub-family SILENOIDEAE:

The characters which are taxonomically important to delimit the genera are:

1. Number of carpels.
2. Presence or absence of septa at the base of the ovary.
3. Nature of fruit—capsule or berry-like.
4. Simple or bifid nature of capsule teeth.
5. Nature of calyx—inflated or not, nerves of calyx.
6. Nature of seed-coat, its ornamentation.

The number of carpels is not always a constant character. There is a tendency of reduction of carpel number in the whole Caryophyllaceae. So delimitation of genera should not be based on carpel number.

Septation of ovary is also not a constant character. Bocquet (1959) has observed that the base of the ovary is always plurilocular at least in the young flower. The septations develop slower than the ovary walls and the central placenta. So the loculi are not closed. In different species the process is more or less accelerated so that the height of the septations is variable. When it is low, the ovary remains unilocular. There is no difference in the general structure of a unilocular and a plurilocular capsule—it is only the degree of realisation of an evolutionary tendency.

The berry-like fruits and scrambling habit is found in *Cucubalus*. Though the structure of fruit approaches that of a capsule, it is a false berry. In all other genera of the Silenoideae, the fruit is a capsule.

The systematic value of the capsule teeth of Silenoideae was first recognised by Roehling (1812). The capsule valves are bifid in species of *Silene* and *Melandrium*, the number of teeth becoming 10, double as many as styles. But in *Lychnis* there are 5 entire valves of capsule. This character is relatively constant and so it is reliable. Chowdhuri (1957) merged *Melandrium* with *Silene*, both having twice as many as capsule teeth as styles. He conserved *Lychnis* and *Silene* distinguishing them by entire and bifid teeth of the capsules respectively. Kruckeberg (1962) studying on the intergeneric hybrids in the Lychnideae, however stated that capsule teeth character is extremely variable in hybrids and such hybrids support the lumping of the species into a single genus. Recent authors as Dandy (1958), Clapham *et al.* (1959), Bocquet and Baehni (1962) support this classification of Chowdhuri, based on simple and bifid nature of capsule valves.

Nature of calyx is an important character in *Silene* and related genera. Inflated calyx is a character of *Silene* but in *Lychnis* the calyx is not inflated. The membranous nature and nervation of calyx are also important characters.

The form of seeds as orbicular, discoid, peltate, reniform or cochleate, etc., presence or absence of tubercles, the flat or concave surface of seeds—these are also useful characters.

Sub-family ALSINOIDEAE

The critical characters are the following:

1. Habit.
2. Inflorescence.
3. Nature of calyx.
4. Staminal glands.
5. Carpel number.
6. Capsule dehiscence.
7. Nature of seeds.

Habit is extremely variable in the Alsinoideae. Small slender annuals, densely pulvinate alpine plants, lax broad leaved mesophytes, various forms are found.

Dichasial cymes are the characteristic inflorescence, but modification such as reduction to solitary flower, aggregation into heads or umbels are taxonomically important. Nature of bracts such as scarious or leaflike or setaceous is also useful.

Nature of calyx may be various. The sectional classification of *Arenaria* is based primarily on sepal characters, specially the apex, base and nerves.

Staminal glands: Williams (1898) based his classification of *Arenaria* mainly on staminal gland structure. McNeill (1962) is of opinion that glands or equivalent structures are always present with the outer stamen whorl. Williams' "absence of glands" means very reduced structures showing a continuous gradation to the prominent 5-gland condition.

Reduction of carpel number occurs in plants with both antisepalous and antipetalous condition of carpels. In one species of *Cerastium* it is reduced to 3. Further reduction to 2 carpels is found in widely separated taxa *e.g. Lepyrodiclis, Brachystemma* and *Arenaria*.

Capsule dehiscence in the classification of Alsinoideae was first considered important by Gaertner (1791). McNeill (1962) has stated that the character of capsule dehiscence provides the most natural arrangement of genera. He has separated *Minuartia* having as many valves as styles from *Arenaria* having twice as many valves or teeth as styles.

The nature of seed is important in the classification of Alsinoideae. Seeds may be flat, reniform or subglobose or irregular, sometimes compressed or winged. The colour may be reddish or black or buff or straw-colour. Seeds may be smooth or rough with cellular mark on the testa. The cells develop into tubercles in some species. Seeds with dorsal papillae are called papillose.

GARDEN PLANTS

The family contains a large number of plants with beautiful showy flowers which are cultivated in gardens. The most well known garden flowers are the pinks (*Dianthus chinensis* L.) and carnations (*Dianthus caryophyllus* L.). The genera *Lychnis, Silene, Gypsophila, Saponaria* and some other genera have some species which are cultivated in Indian gardens. Some other species which are cultivated in gardens are the following: *Dianthus barbatus* L. (Sweet Williams), *Saponaria officinalis* L. (Bouncing bet), *Silene armeria* L. (Sweet William catchfly), *Lychnis viscaria* L. (German catchfly), *L. coeli-rosa* Desr. (Rose of Heaven), *L. coronaria* (L.) Desr. (Rose campion), *Gypsophila elegans* Bieb., *G. paniculata* L. (Baby's breath), *Cerastium tomentosum* L. (Snow in summer).

MEDICINAL & ECONOMIC IMPORTANCE

There are a few plants which are sometimes used for medicinal or other purposes (Chopra *et al.*, 1956; Kirtikar & Basu, 1918).

1. *Arenaria holosteoides* Edgew. is said

to be used as vegetables in Chamba and Ladak.

2. *Arenaria serpyllifolia* L. Herb used in China for bladder diseases, considered valuable for calculus troubles and acute and chronic cystitis.

3. *Holosteum umbellatum* L. is said to possess refreshing and slightly demulcent properties.

4. *Polycarpaea corymbosa* Lam. is grazed by domestic animals. Herb administered internally and externally as remedy for venomous bites. Leaves are pounded and applied as poultice over boils and inflammatory swellings. Given in the form of pills with molasses in jaundice.

5. *Polycarpon prostratum* (Forsk.) Aschers. & Schweinf. Leaves used as vegetables. Infusion of roasted leaves given for cough following fever.

6. *Saponaria officinalis* L. contains saponin and is used for washing. So this plant is commonly called *soapwort*. The decoction of roots is employed as an external application to cure itch and also given internally for gout, rheumatism, etc.

7. *Spergula arvensis* L. is sometimes used as fodder. Used as a diuretic in Columbia.

8. *Stellaria media* (L.) Vill. is used as vegetable by natives of the Nilgiris and Assam. Plant employed in plaster for broken bones and swellings as it is supposed to be cooling and binding.

9. *Vaccaria pyramidata* Medik. has febrifugic and tonic properties in fevers. The saponin-containing sap is a remedy for itch and used by the natives as a substitute for soap.

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